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MACHINE TOOL

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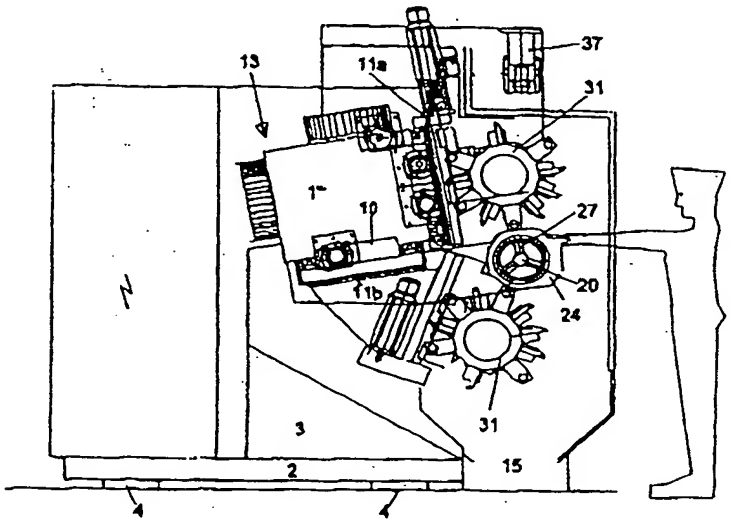
Abstract

The invention relates to a machine tool which is simple and inexpensive to produce but which can be configured very variably and can be fitted with various machine modules. In addition, despite good chip removal properties, the inventive machine tool is suited to a simple energy supply which is relatively unsusceptible to interference, especially for the lower machine modules. The inventive machine tool has a bed on which guides are located for bearing machine modules and is characterised in that said bed is a portal bed which is elevated on at least one bed foot.



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MACHINE TOOL

I. Field of application

The invention concerns a machine tool, e.g., a turning machine.

II. Technical background

Such machine tools typically have a bed on which the individual machine modules, e.g., one or more tool carrier systems, one or more workpiece carrier systems, measurement units, loading and unloading devices, etc., are arranged.

For this reason, the bed must be built as inherently stable as possible because only in this way is high precision possible during processing of the workpieces produced on the machine tool.

In order to be able to move the machine modules in the longitudinal direction of the bed, or the Z direction, there are guidance tracks on the bed, and these machine modules run on the tracks.

Here, different bed forms are known, e.g., for turning machines, cradle beds, inclined beds, vertical and overhanging beds, etc. However, as a rule, the beds stand flat on the foundation or on a base plate.

The different bed forms are used, on the one hand, for achieving good discharge of shavings resulting from processing, and on the other hand, for achieving as high a stability of the bed as possible, above all, from a dynamic standpoint.

Here, one problem is also the power supply of machine modules in the front region of such beds, which, in turn, have motors, e.g., for driven tools and for moving the workpiece carrier unit, e.g., a tool revolver, etc. Here, above all, the power supply of the machine modules arranged underneath the processing position is critical because their power supplies, which must be flexible due to the capability of longitudinal motion, lie in the region of the shavings clearance.

III. Description of the invention

a) Technical task

Therefore, one problem of the invention is to create a machine tool, which, despite being able to be manufactured simply and cost-effectively, can be configured very variably and which can be equipped with machine modules, and in addition, despite good shavings removal, can be equipped with a simple power supply that is only slightly susceptible to interference, particularly for the lower machine modules.

b) Solution of the problem

This problem is solved by the characterizing features of Claim 1. Advantageous embodiments result from the subordinate claims.

Through the upright position of the bed relative to a gantry bed, particularly at only two feet at the end of the bed, each type of power supply can be adapted in nearly arbitrary numbers under the bed and can be moved in the longitudinal direction together with the machine modules supplied with power by the power supplies. In this way, restrictions on whether and which machine modules can be used on the lower part of the bed, particularly underneath the processing position, are eliminated.

The reason against such an upright position before was that in order to achieve better processing results, the bed and also the sub-frame carrying the bed for a machine tool were built more stable, particularly against vibrations. For this reason, beds were previously completely flat or set on many contact points relative to the foundation.

So that the bed is set high enough that the lower front edge of the gantry bed is approximately at chest height of an operator standing in front of the machine, a spindle stock can also be guided along the gantry bed, either at its front side or at its lower side, approximately at this height, whereby the tool unit guided at the lower side is very easy to access in a way that does not contaminate the power supply and without, on the other side, the processing position, e.g., the center of rotation of a turning machine, coming to rest too high for the operator standing before the machine, also when the processing position is in the lower height region of the bed, particularly in the lower half, because in the lower region, particularly guided on the lower side, there is a lower tool support or the spindle stock.

Because the gantry bed has an approximately rectangular cross section with outer sides, particularly the lower side and front side, which in any case are at right angles to each other and which support the individual guidance tracks, the processing of the bed can be performed easily and cost-effectively. Guidance tracks running exclusively in the Z direction and the use of identical guidance tracks can, on the one hand, further reduce costs and, on the other hand, the individual machine modules can be set on different guidance tracks. For this reason, all guidance tracks in both cross directions (X and Y direction) are built with a positive fit, particularly so that they engage from behind relative to the displacement direction (Z direction).

In addition, the gantry bed has continuous through-holes open on both sides in the longitudinal direction, which can be used for passing lines, particularly power supply lines, from one end of the machine to the other. For production from plastic or a concrete-plastic mixture, the through-holes as a rule consist of several circular through-holes, particularly arranged in a circle. For production of the gantry bed from cast steel, the through-holes remain between the surrounding outer shell and the integrated ribs; thus, there are two or four large hollow chambers.

The height of the gantry bed is 1.0 to 1.5 times as high as the depth of the gantry bed, particularly square, and guides are preferably arranged only on the bottom side and front side, and on the bottom side there is a pair of guides and on the front side there is at least one pair of guides.

On the top side, preferably there are no guidance tracks in order to allow the mounting of power supplies there.

In the best case, a guidance track can still be arranged at the front edge of the top side, where the top, front edge of the bed, however, is only slightly encompassed by a machine module.

In order to protect the guidance tracks from contamination, there are preferably covers that can telescope in the longitudinal direction and that preferably always cover a pair of corresponding guidance tracks, thus, e.g., the pair of guidance tracks on the bottom side.

The bed feet are preferably not a component of the bed, but instead separate individual parts. The gantry bed preferably stands on a base plate, which is formed as a welded construction, and also the bed feet are preferably welded constructions, which are screwed to the base plate or built in one piece with this plate. In this way, a relative displacement of the bed on the support components, thus, e.g., the base plate, is possible due to heat expansion of the bed during processing, e.g., through corresponding play in the screws.

The necessary switching cabinets and power supply devices, such as hydraulic and pneumatic pumps and the like, preferably stand behind the bed of the machine tool also on such a base plate, and also a loading and unloading system for the machine is either attached to this base plate or directly to the machine bed at the front face. The switching cabinets and power supply devices can be placed as close as possible to the rear side of the bed or at such a distance from it that a service passage is produced to allow service personnel to perform maintenance and repair work on the back side of the machine or to monitor the machine during operation.

In this way, additional devices, that is, switching cabinets and power supply devices, can be mounted on the bed or the base plate, preferably with the aid of an auxiliary construction, a so-called switching cabinet frame. If desired, they can be arranged in the position as close as possible or in the separated position for the purpose of realizing the service passage, according to the installation space available to the user.

In all cases, the machine is transported in the completely assembled position, that is, as a so-called lifted machine, however, preferably with the close position of the additional unit on the bed, so that the bed can be lifted with all auxiliary units and machine modules located inside, e.g., on the crane hook, and set in the position at a distance from the bed only after installation of the additional units.

In addition, there is still sufficient space for power supply devices, e.g., cable pulling devices, also in the close position between the switching cabinets, which as a rule are arranged along the entire longitudinal extension of the machine, and the rear side of the bed. In particular, at the height of the top edge of the gantry bed there are cable pulling devices, which supply the tool modules with power.

The removal of shavings occurs by means of a shavings conveyor, which is arranged directly before the front side of the machine bed at a corresponding depth. For this purpose, a suitable sheet is mounted over the base edge between the posts of the bed.

A gantry bed that is very uniform relative to the stability of the bed due to its square shape with identical, parallel Z guides can be used for different machine constructions.

A preferred embodiment is the configuration as a turning machine, for which, particularly the spindle stock, and optionally the additional tailstock is guided at the lower side of the gantry bed, while machine modules, usually tool slide systems, are guided at the front side and likewise at the bottom side.

While the spindle axis is directed in the Z direction in the conventional construction, also a cross arrangement, that is, e.g., in the vertical direction (X direction), can be selected, particularly if the spindle stock is guided along the guidance tracks of the top side of the gantry bed.

Also, a construction as a milling machine with a tool receptacle in the upper region of the front side of the gantry bed is possible, with milling units, which are guided along the guidance tracks of the top side. If, in addition, the unit carrying the workpiece is guided longitudinally in the lower region of the gantry bed, the longitudinal guides of the upper region of the front side are also available for tool modules, measurement modules, or the like. Thus, an implementation of the machine as a mixed milling/turning machine is also possible, that is, it can carry both tool modules that are purely milling modules and also tool modules that correspond to a turning machine, thus a tool revolver with cutting tools and if necessary, also drive tools.

c) Embodiments

An embodiment according to the invention is described in more detail in the following with reference to the figures. Shown are:

Figure 1, a turning machine according to the invention in side view, with switching cabinets arranged close to the bed of the machine, and

Figure 2, another turning machine in side view.

As Figure 2 shows, the gantry bed 1" is mounted relative to the base, here the base plate 2, by means of two bed feet 3, which stand, as seen in the Z direction, under the two longitudinal

side ends of the gantry bed 1", and extend in the depth direction (Y direction) of the bed, preferably over the entire depth.

The gantry bed 1" is a self-supporting frame with hollow spaces, particularly through-holes 6' in the longitudinal direction, and is made of concrete or a plastic-concrete mixture for the solution from Figures 1 and 2.

At the bottom side 9 and the front side 8 of the upright square cross section of the gantry bed 1", 1'" there are guidance tracks 5a-5d, and a first pair (5a, 5b) at the bottom side, close to the front and at the back edge of the bottom side 9, and two guidance tracks 5c, 5d at the front side 8, wherein the topmost are close to the top edge and the lowermost are close to the bottom edge. The distance between the guidance tracks of a pair is preferably equal.

The through-holes 6' have an approximately square cross section, and there are four through-holes arranged in a square around the center of the bed, so that the remaining material thickness to the top side, the bottom side, and also between the through-holes is approximately equal, and likewise, to the front side 8 and the back side 13. The individual guidance tracks 5 are configured identically, and likewise the guidance shoes 16 running on the guidance tracks. While the guidance tracks extend over essentially the entire length (Z direction) of the gantry bed 1", 1'", namely over the entire range of motion of the machine modules running these tracks, each machine module usually only has one guidance shoe 16, which is located at the beginning and end in the longitudinal direction and which runs on the corresponding guidance track 5. In this way, the guidance tracks 5 and also the guidance shoes 16 on these tracks, which are usually configured as rolling guidance shoes, are configured to engage with a positive fit in the two other spatial directions (X and Y direction), which offers the advantage that all longitudinal guides are configured identically, independent of the direction gravity acts on the guidance track 5.

Between the guidance tracks arranged in pairs are groove-shaped recesses 10 that run in the longitudinal direction and that are arranged in the corresponding outer sides of the gantry bed 1", 1'" in order to provide space for the threaded spindle 33, with whose aid the machine modules running on the guides are driven in the Z direction.

At the back side 13 and the top side 7 of the gantry bed 1", 1'", there are known cable pulling devices 17a, 17b, in order for the power lines to track the machine modules moving in the longitudinal direction. From the cable pulling devices curved in the form of a U and consisting of individual members, in this way, e.g., the top device 17b has one free end that is allocated to the gantry bed 1", 1'" close to its back edge, and the other end, in contrast, is allocated to the upper tool support. Each individual tool unit is allocated to a separate cable pulling device.

For the back cable pulling device 17a, the allocation of the top end is performed for the lower tool unit at a height that is close to the lower side of the gantry bed 1", 1'", so that the

power lines guided further from this lower end of the trailing end device 17a can then be guided between the lower side of the gantry bed 1", 1'", thus in this case the base plate 2, in the height region of the bed feet, relative to the lower side 9 and the lower machine unit moving there longitudinally.

For machine modules, the machine of Figures 1 and 2 has the following equipment: on the two guidance tracks 5c and 5d of the front side 8 runs a top tool support, consisting of a top longitudinal slide 28a and a top cross slide 29a that can travel on these tracks in the X direction and that supports, in turn, a tool revolver 31.

The spindle stock 24, on which, with the aid of a clamping chuck 27 (not illustrated), the workpiece can be held and rotated on the rotating center 20, can be guided to the lower side at the gantry bed 1", 1'", either fixed or also movable along the guidance tracks 5a, 5b.

Likewise, the two lower guidance tracks 5a, 5b of the lower side 9 of the gantry bed 1", 1'" carry a lower tool support, namely a longitudinal slide 28b, on whose cross guides a cross slide 29b can move in the Y direction. The cross slide carries a tool revolver 31, whose tools can work on the workpiece.

In the present case of Figures 1 and 2, the axes of rotation of the tool revolver 31 are parallel to the Z direction for all tool units.

As Figure 1 shows, there are different covers available at the tool machine: first, a work space cover 22 covering the entire work space at the front side, which can be opened in the longitudinal direction (not illustrated), optionally only at the front side, only at the top side, or at both.

The work space is limited at the rear side by guidance covers 11a, 11b, which are arranged for the pairs of guidance tracks 5 and thus for the gantry bed 1", 1'", in order to keep contaminants produced in the work space from the guidance tracks 5.

The gantry bed 1", 1'" is arranged by means of the bed feet 3 on a base plate 2, which can itself be adjusted by means of base plate feet 4 on the foundation so that the plate is exactly horizontal. Over the front top edge of the base plate 2 there is an inclined plate that extends towards the front as it goes down, e.g., a baffle plate. The gantry bed 1", 1'" stands so far in front of the base plate 2 that its front side 8 is already over this inclined plate 14. Therefore, the shavings are more easily guided downwards directly onto the shavings conveyor 15, which is arranged directly in front of the base plate.

While in Figure 2 the essentially square gantry bed 1" is aligned with vertical and horizontal outer surfaces, respectively, the likewise approximately square gantry bed 1'" of Figure 1 is inclined relative to this configuration. The front-most point of the cross section of the gantry bed 1'" directed towards the operator is its front lower edge. The front side 8 slopes

slightly backwards as it continues to the top, while the bottom side 9 slopes slightly backwards, with a tilt of 5°-15° from the vertical and horizontal, respectively.

In addition, in Figure 1 the X axis of the lower support relative to the X axis of the top support is not at an angle of 180° but is instead inclined by, e.g., approximately 30° downwards. The X axis of the lower support here runs approximately vertical.

This causes a smaller overhang of the lower tool support in the Y [direction] and also an approximately smaller overhang of the spindle stock 24, for improved downward falling of the shavings.

In both figures, the machine tools are inserted by a loading and unloading system 37, whose gripper is illustrated above the top tool revolver 31 and can move in the Z and X direction so that it can at least move the rotating center 20 in order to exchange workpieces.

In addition, this rail configuration also offers the advantage, in addition to the generally known loading possibilities from the front, from the side, and from the top, also the ability to load from below, because a gripper or a transport device for workpieces to be loaded and unloaded and/or tools can be provided (not illustrated) under the upright bed, and thus perpendicular to the Z direction, usually horizontal. This is, on the one hand, very economical, and on the other hand, an operator-friendly and quick loading and unloading possibility.

List of reference symbols

1", 1"'	Gantry bed
2	Base plate
3	Bed feet
4	Base plate feet
5	Guidance frame
6, 6'	Through-hole
7	Top side
8	Front side
9	Bottom side
10	Recesses
11a, 11b, 11c	Guidance cover
12a, 12b	Intermediate covers
13	Back side
14	Inclined plate
15	Shavings conveyor
16	Guidance shoe
17	Cable pulling devices

18	Switching cabinets
19	Power supply devices
20	Rotating center
21	Switching cabinet frame
22	Work space cover
23	Passage
24	Spindle stock
25	Tailstock
26	Spindle sleeve
27	Clamping chuck
28a, 28b	Top longitudinal rail
28c	Lower longitudinal rail
29a, 29b	Top cross rail
29c	Lower cross rail
30	Cross guides
31	Tool revolver
32	Power line
33	Threaded spindle
34	Service passage
35	Milling head
36	Measurement head
37	Loading and unloading system

Claims

1. Machine tool with a bed on which guides for carrying machine modules are arranged, characterized in that the bed is a gantry bed (1",1"') mounted on at least one bed foot (3).

2. Machine tool according to Claim 1, characterized in that the gantry bed (1",1"') is mounted on at least two bed feet (3) which are positioned at a distance in the longitudinal direction (Z direction) and which are arranged particularly at the ends of the gantry bed (1",1"') in the Z direction.

3. Machine tool according to one of the preceding claims, characterized in that the space under the gantry bed (1",1"') between the bed feet (3) perpendicular to the Z direction is freely accessible and is used particularly for a power supply from the rear side of the gantry bed (1",1"') for machine modules guided at the lower side (7).

4. Machine tool according to one of the preceding claims, characterized in that the machine modules can be, in particular, tool slide systems, spindle stocks, tailstocks, and are fixed or movable in the Z direction on the guidance tracks (5).

5. Machine tool according to one of the preceding claims, characterized in that the gantry bed (1" 1'") has guidance tracks (5) running exclusively in the Z direction.

6. Machine tool according to one of the preceding claims, characterized in that the gantry bed (1",1'") has a rectangular, particularly upright, cross section perpendicular to the Z direction.

7. Machine tool according to one of the preceding claims, characterized in that the bed feet (3) are configured so high that the lower side (9) of the gantry bed (1",1'") is at least at chest height of the operator over the base and the gantry bed has guidance tracks (5) running in the longitudinal direction at least on its front side (8) and its lower side (9).

8. Machine tool according to one of the preceding claims, characterized in that the gantry be (1",1'") has a square cross section.

9. Machine tool according to one of the preceding claims, characterized in that the rectangular cross section of the gantry bed (1",1'") is inclined by 5-20°, preferably by 8-13°, backwards relative to a position vertical in the front side (8) and horizontal in the lower side (9), so that the front side (8) slopes towards the front as it continues down.

10. Machine tool according to one of the preceding claims, characterized in that on the lower side (9) there are two guidance tracks (5a,5b) running in the longitudinal direction, which are positioned, in particular, close to the front and back end of the lower side (9).

11. Machine tool according to one of the preceding claims, characterized in that the gantry bed (1",1'") is arranged with its top side (7) and/or its lower side (9) parallel to the base plate and particularly vertical.

12. Machine tool according to one of the preceding claims, characterized in that the gantry bed (1",1'") is dimensioned to be stable and also self-supporting when equipped with machine modules.

13. Machine tool according to one of the preceding claims, characterized in that the gantry bed (1",1'") is made of plastic and/or concrete and/or a mixture of the two materials or of cast steel.

14. Machine tool according to one of the preceding claims, characterized in that the gantry bed has at least two through-holes (6,6') continuous in the Z direction.

15. Machine tool according to Claim 14, characterized in that these through-holes (6,6') are used for passing power supply lines in the longitudinal direction.

16. Machine tool according to one of the preceding claims, characterized in that all of the guidance tracks (5) running in the Z direction on the gantry bed (1",1'") are identical guidance tracks and extend, in particular, over the entire length of the gantry bed (1",1'").

17. Machine tool according to one of the preceding claims, characterized in that the gantry bed has guidance tracks (5) at least on its lower side (8) and on its front side (8) in the longitudinal direction.

18. Machine tool according to one of the preceding claims, characterized in that on the front side (8) there are at least two guidance tracks (5c-5d) running in the longitudinal direction, wherein, particularly the topmost and the lowermost of the guidance tracks of the front side (8) are arranged close to the top edge or lower edge of the gantry bed (1",1'").

19. Machine tool according to one of the preceding claims, characterized in that the top side (7) has no guidance tracks.

20. Machine tool according to one of the preceding claims, characterized in that the gantry bed (1",1'") is built in one piece and the guidance tracks (5) are screwed, in particular, onto the gantry bed (1",1'").

21. Machine tool according to one of the preceding claims, characterized in that the guidance tracks (5) have guidance cross sections with positive fit engagement in both cross directions to the Z direction, particularly a mushroom-shaped cross section.

22. Machine tool according to one of the preceding claims, characterized in that the gantry bed (1",1'") stands on a base plate (2) by means of bed feet (2), which also supports, in particular, switching cabinets, power supply devices, such as hydraulic and pneumatic pumps, and in particular, an automatic loading and unloading system (37) for workpieces and/or tools.

23. Machine tool according to Claim 22, characterized in that the automatic loading and unloading system (37) is attached directly to the gantry bed (12).

24. Machine tool according to one of the preceding claims, characterized in that the bed feet (3) are built in one piece together with the base plate (2).

25. Machine tool according to one of Claims 1-23, characterized in that the bed feet (3) are separate components.

26. Machine tool according to one of the preceding claims, characterized in that the attachment of the gantry bed (1",1'") allows relative motion relative to the bed feet (3) and/or the base plate (2), particularly in the Z direction and the horizontal cross direction (Y direction).

27. Machine tool according to one of the preceding claims, characterized in that a shavings conveyor (15) is arranged directly in front of the base plate (2).

28. Machine tool according to one of the preceding claims, characterized in that the machine modules are guided along the guides (5) running in the Z direction with the aid of guidance shoes (16), particularly ball guidance shoes, which the guidance tracks (5) engage with a positive fit and which have a shorter length than the longitudinal extension of the machine module.

29. Machine tool according to one of the preceding claims, characterized in that at least one cable pulling device (17a) for tracking cables in the Z direction is arranged along the back side (13) of the gantry bed (1",1'"), which has two free ends pointing in the Z direction, of which one is fixed relative to the gantry bed and the other is fixed relative to the machine module to be supplied with power, and by means of the cable guided in this cable pulling device (17a), a machine module guided on the two guidance tracks (5a,5b) of the bottom side (9), particularly a lower tool support, is supplied with power.

30. Machine tool according to one of the preceding claims, characterized in that in the upper region, particularly on the top side (17b) of the gantry bed (1",1'"), there is a cable pulling device (17b).

31. Machine tool according to one of the preceding claims, characterized in that the switching cabinets (18) and/or power-supply devices (19), as well as additional auxiliary units, are arranged on the base plate (2) at a distance to the back side (13) of the gantry bed such that passage is possible during the operation of the machine tool.

32. Machine tool according to one of the preceding claims, characterized in that the machine tool is a turning machine.

33. Machine tool according to one of the preceding claims, characterized in that the machine tool is a turning machine and has a tailstock (25), which is driven by a mechanical element in the Z direction along the longitudinal guides (5c,5d) carrying it and whose spindle sleeve is pretensioned to the tailstock housing, particularly by means of a spring, and wherein the tailstock also has no other power supply.

34. Machine tool according to one of the preceding claims, characterized in that the machine tool has a loading device, whose transport direction, particularly of its transport device, extends under the gantry bed (1",1'"), particularly perpendicular to the Z direction, particularly in the horizontal direction.

35. Machine tool according to one of the preceding claims, characterized in that the transport device of the loading and unloading device is connected to the base plate (2).

Fig. 1

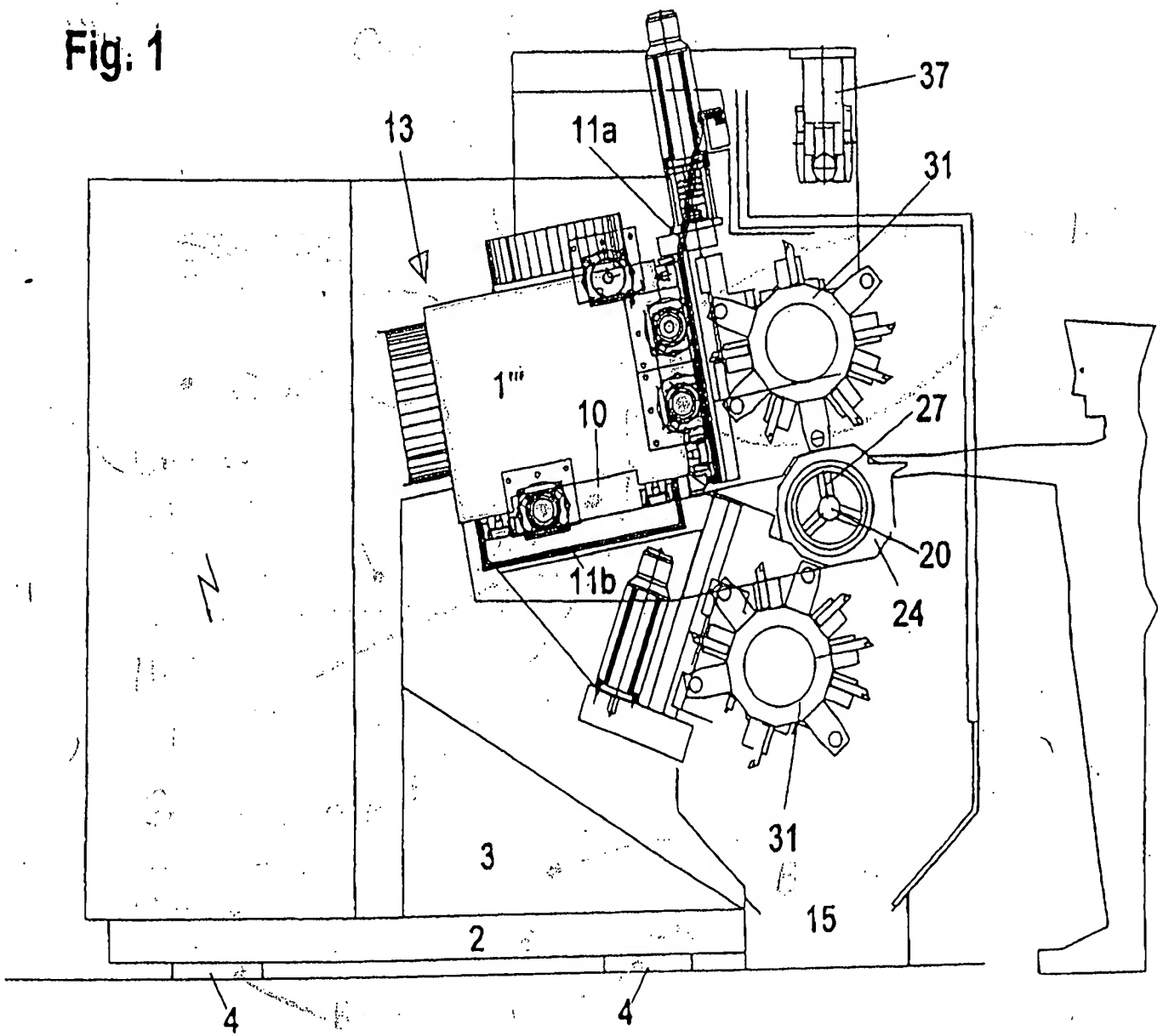
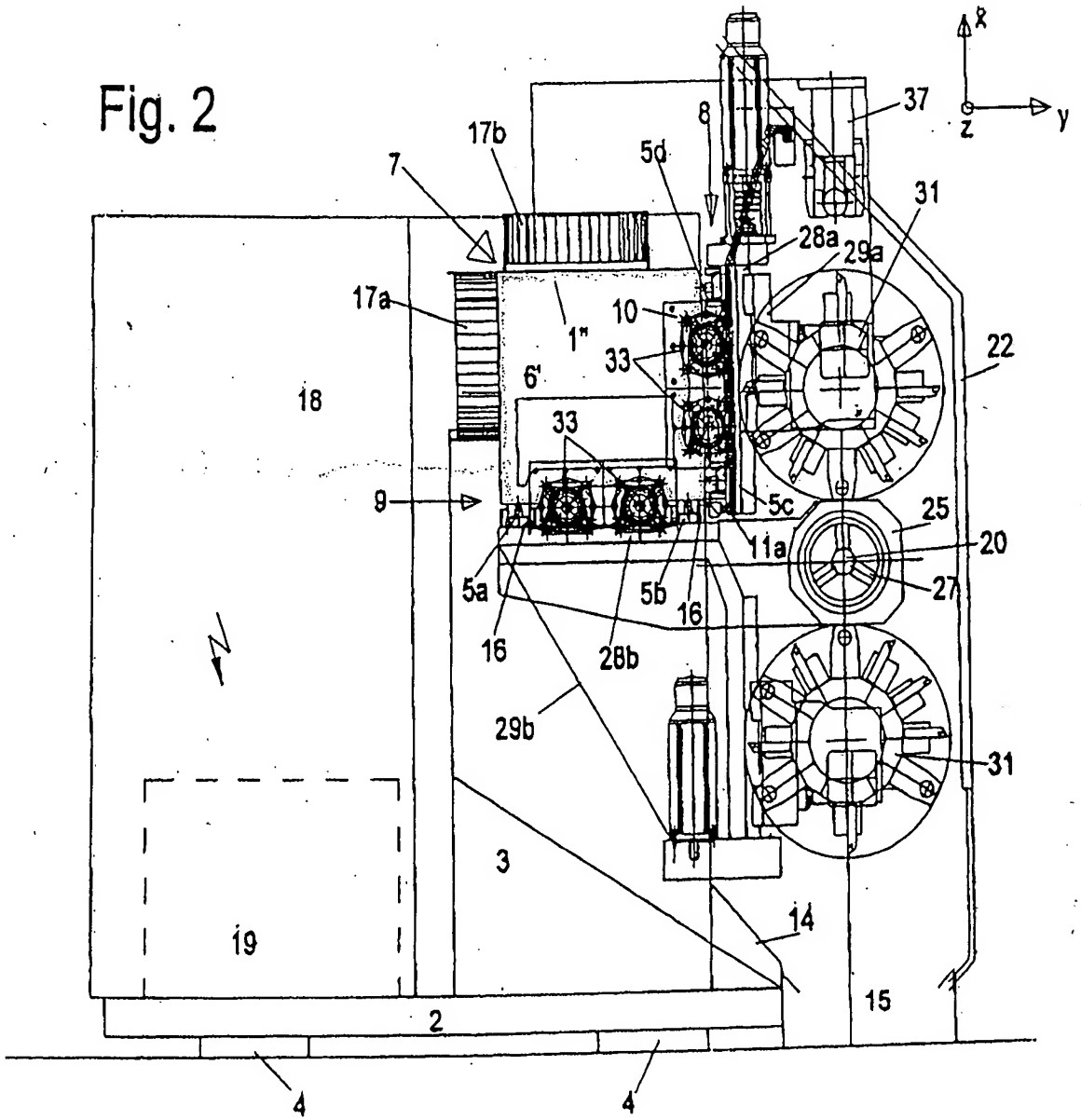


Fig. 2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